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Evaluation of Pheromone-Baited Blacklight Traps for Controlling Cabbage Loopers on Shade-Grown Tobacco in Florida

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The biology of the cabbage looper (*Trichoplusia ni* (Hübner)) has been discussed by McKinny (*11*),[2] Shorey (*15*), Shorey et al. (*16*), and Sutherland (*20*). Several authors have reported that when cabbage loopers were abundant, large numbers of the moths were taken in blacklight traps (Merkl and Pfrimmer *12*, Pfrimmer *14*, and Hollingsworth et al. *9*).

Sirrine (*17*) was the first to suggest that blacklight traps be used to control populations of *T. ni*, but Nobel et al. (*13*) were unsuccessful in controlling this species on a number of vegetable crops near Batesville, Tex. These authors reported that when one trap per 21 acres was used, the eggs and larvae averaged 2.7 per 100 samples as compared with 2.0 in an untrapped area. However, tests conducted in Indiana with one blacklight trap in garden plots 60 feet square indicated adequate cabbage looper control on cabbage (Deay *3*).

Henneberry et al. (*7, 8*) in California found that blacklight trap catches of looper males increased when virgin female moths were placed adjacent to the trap. Berger (*1*) isolated, identified, and synthesized the sex pheromone of the female cabbage looper. Later Wolf et al. (*21*) found that the synthetic pheromone was as effective as live virgin females in increasing male looper catch in blacklight traps.

The cabbage looper has become a major pest of shade-grown cigar-wrapper tobacco in the Georgia-Florida area because of its tolerance for currently recommended insecticides. Wild hosts such as the cocklebur are abundant and help to sustain the natural

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[2] Italic numbers in parentheses refer to Literature Cited, p. 11.

populations. Because of the encouraging results obtained by Lawson et al. (*10*), Gentry et al. (*6*), and Stanley and Taylor (*19*) with traps against the tobacco hornworm (*Manduca sexta* (Johannson)) and the need for an alternate method for controlling the cabbage looper, growers installed 1,200 blacklight traps in a 400-square mile shade-tobacco area around Quincy, Fla., in 1966 in an attempt to suppress the tobacco hornworm and other Lepidoptera attacking tobacco.

In the winter of 1967 permission was obtained from the growers to bait each of the traps with the artificial female cabbage looper sex pheromone and to evaluate the combined effects of the light traps and the pheromone on the cabbage looper population in the 400-square mile area.

Equipment

The blacklight traps used were of the type described by Lawson et al. (*10*) and Stanley et al. (*18*). They were approximately 10 feet above the ground. Moths attracted by the light fell into the funnel and down the metal tube into a 3-mm. hardware cloth collecting basket. Traps used for counting moths were equipped with the type of collection containers described by Dickerson et al. (*5*). In the 400-square mile area, trap distribution averaged three per square mile, but this varied considerably because of heavy wooded areas and the availability of electric power.

Three types of pheromone dispensers were used: Sand, wick, and plastic vials. During 1967 the sand type described by Wolf et al. (*21*) was used. It was necessary to recharge this dispenser every 3 weeks. The wick-type dispenser, similar to ones utilized in tests at Red Rock, Ariz. (Debolt *4*), was used during 1968. This dispenser was more effective than the sand type and attractancy lasted up to 3 months. The wick dispenser was replaced in April 1969 by a 2/5-dram container, manufactured by Olympic Plastics Co., Los Angeles, Calif. The plastic vial-equipped trap caught 28 percent more males than the traps with wicks. The plastic vial dispensers cost much less per unit than the sand or wick dispensers and remained effective for more than 3 months. Dispensers were hung beneath the trap funnel on the pole supporting the trap.

Methods

Criteria used in evaluating the effect of the blacklight traps on controlling the cabbage looper were number of moths caught, egg

and larval counts, percent egg hatch, percent of females mated, and number of matings per female.

Blacklight trap data were recorded from 13 traps inside the 400-square mile area and six traps outside. Inside the area these traps were located diagonally from southwest to northeast at intervals of about 2 to 3 miles. The six outside traps were located about 60 miles northeast of the center of the 400-mile area, near Moultrie, Ga., in a flue-cured tobacco-growing area. These traps were spaced about 3 miles apart. Insect counts were taken three times per week when populations were high and two times per week when they were low.

Egg and larval data were collected from collard (*Brassica oleracea* var. *acephala*) plots, 12 plots inside and six outside the area. The inside plots were located along the same route as the blacklight traps and spaced 2 to 3 miles apart. The six outside plots were located in the same general area as the blacklight traps near Moultrie. Counts were taken twice a week on 25 predetermined plants from each plot. A 100-egg sample was collected weekly from the inside and outside plots to determine the percent egg hatch from May through September.

Data on mating were obtained by examining female moths collected from traps inside and outside the area at weekly intervals during June, July, and August for the presence of spermatophores. The technique used was described by Callahan (*2*).

An adequate check area was impossible to provide because the growers installed blacklight traps over the entire shade tobacco-growing area in west Florida. The Moultrie, Ga., area was the nearest and best check available. Although populations in these two areas would not be comparable, they probably would be similar.

Results

Seasonal abundance of the cabbage looper populations from 1967 through 1969 in the 400-square mile area is presented in figure 1. In 1968 and 1969, when all the traps in the 400-square mile area were baited with the pheromone, the population developed 3 to 4 weeks later and decreased about 2 to 4 weeks earlier than in 1967, when only 13 traps inside the area were baited. In 1967, peak populations (assuming trapping data indicate the population) were reached in June, but in 1968 and 1969 they were not reached until July (table 1). Collection of male moths from the traps in 1968 and 1969 were 42 and 60 percent

less, respectively, than in 1967. Damage to shade tobacco by the cabbage looper during the 2 years all the traps were baited did not reach an economic level because of the delay in population buildup. The growing season extends from mid-March through June.

In 1968 and 1969 the number of male moths caught per trap in the 400-mile area from March through September was 82 and

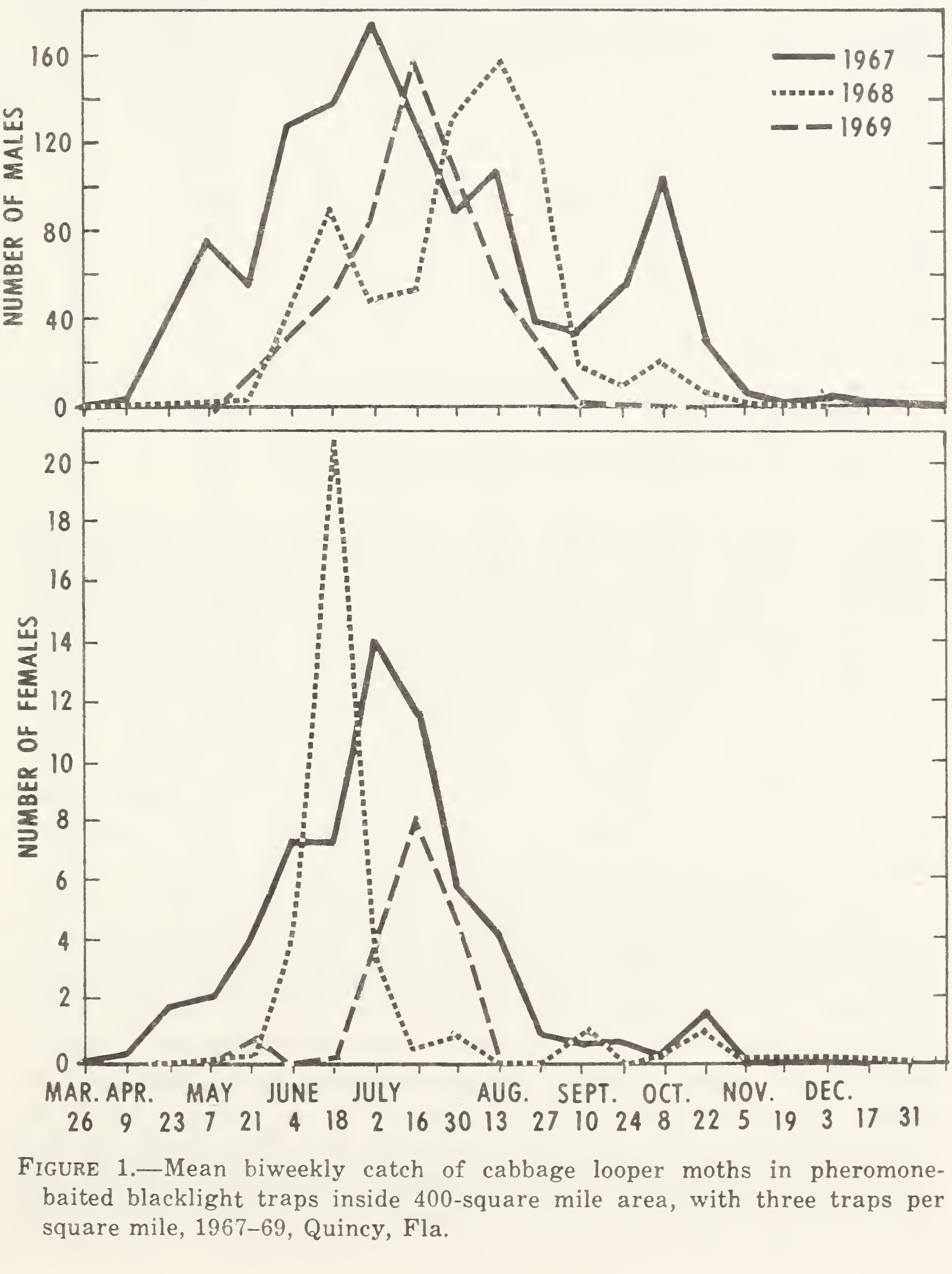

FIGURE 1.—Mean biweekly catch of cabbage looper moths in pheromone-baited blacklight traps inside 400-square mile area, with three traps per square mile, 1967–69, Quincy, Fla.

TABLE 1.—*Collection of cabbage looper moths in pheromone-baited blacklight traps in 400-square mile area, with 3 traps per square mile, Quincy, Fla.*[1]

Month	Mean per trap					
	1967		1968		1969	
	Males	Females	Males	Females	Males	Females
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Jan	0	0	0	0	0.2	0.1
Feb	0	0	0	0	.4	0
Mar	1	0	1	0	0	0
Apr	104	3	5	0	.3	0
May	123	8	6	.2	32	.6
June	308	19	144	25	96	.7
July	305	25	222	4	271	16
Aug	150	5	276	0	88	.1
Sept	91	1	35	1	5	0
Oct	146	2	32	1	2	0
Nov	7	.1	.7	.1	0	0
Dec	6	.1	0	0	0	0
Total	1,241	63.2	721.7	31.3	494.9	17.5

[1] In 1967, 13 traps baited; in 1968–69, all traps baited.

66 percent less, respectively, than in the Moultrie (check) area (table 2). Even though the Moultrie area was located 60 miles north of the center of the 400-mile area, the population developed 2 to 4 weeks later in the 400-mile area. Also, the population decreased 2 to 3 weeks earlier. Populations in the two areas reached the season high during the week of July 30, 1968, and July 9, 1969. The male population in the 400-mile area during these periods in 1968 and 1969 was 82 and 87 percent less, respectively, than in the Moultrie area. The number of female moths caught in both areas was low, averaging less than one per trap per night.

Egg counts in 1968 and 1969 were consistently higher in the Moultrie area than in the 400-mile area (table 3). The survival of larvae was much better in the 400-mile area, but there was little difference in the number of larvae per plant between the two areas (table 3). This could be attributed to heavier insecticide usage in the 400-mile area, resulting in less predaceous and parasitic insects.

The difference in egg hatch between the two areas was not significant; however, hatch in the 400-mile area was consistently lower than in the Moultrie area (table 4).

TABLE 2.—*Comparison of cabbage looper moths collected in blacklight traps in 400-square mile area and in Moultrie area, each trap in both areas baited with 0.1 gram of female cabbage looper sex pheromone* [1]

Date	Mean per trap							
	1968				1969			
	400-mile area		Moultrie area		400-mile area		Moultrie area	
	Males	Females	Males	Females	Males	Females	Males	Females
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Mar. 26	0.07	0	0.33	0	0	0	0	0
Apr. 2	.30	0	.16	0	0	0	0	0
9	.07	0	.42	0	0	0	.03	0
16	0	0	2.42	0	.01	0	.33	0
23	.3	0	.28	0	.01	0	.07	0
30	.03	0	.14	0	.01	0	.28	0
May 8	.19	0	4.21	.07	.01	0	.75	0
15	.53	.03	5.85	.21	.71	.01	1.83	.16
21	.11	0	3.91	0	1.28	.07	2.08	0
28	.07	0	3.41	0	2.56	0	12.83	0
June 4	6	.5	41.41	2.66	2	0	8.08	0
11	8.38	1.93	35.75	1.16	2.5	.01	2.08	0
18	4.84	1.03	25.08	.41	5.2	.01	5.5	.08
25	1.61	.11	4.16	.25	4	.07	2.75	0
July 2	5.38	.38	40.5	.58	8.4	.4	6.67	.08
9	3.5	0	16.38	.16	15.54	.96	121.67	6.08
16	4.15	.07	56.60	1.60	7.17	.2	18.25	1.42
30	14.23	.11	77.75	0	3.4	.27	10	0
Aug. 6	----	---	----	---	6.16	.01	16.75	.5
13	----	---	34.33	0	8.8	0	5.3	0
20	9.61	0	32	0	2	0	4.7	0
27	7.38	0	4.03	0	.1	0	.5	0
Sept. 3	1.69	.15	10.16	.66	.07	0	.5	0
10	----	---	----	---	.3	0	.66	0
17	1.1	0	6.71	0	.25	0	.25	0
24	.7	0	.6	0	0	0	0	0
Mean	3.1	.18	17.53	.32	3.06	.09	9.08	.31

[1] In 400-square mile area, 1,200 traps, with 3 traps per square mile; in Moultrie area, 6 check traps spaced 3 miles apart.

Female moths examined for spermatophores showed no difference in the percent of mated moths between the two areas. However, females inside averaged 2.0 spermatophores per mated female in 1968 and 1.4 in 1969 compared with 2.4 and 1.9 in the Moultrie area (table 5).

TABLE 3.—*Comparison of egg and larval counts in 400-square mile area and in Moultrie area, each trap in both areas baited with 0.1 gram of female cabbage looper sex pheromone* [1]

Date	Mean per 25 plants							
	1968				1969			
	400-mile area		Moultrie area		400-mile area		Moultrie area	
	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Mar. 26	0.03	0	0	0	0	0	0	0
Apr. 2	.3	.03	.2	0	0	0	0	0
9	0	0	0	0	.31	0	0	0
16	0	0	0	.2	.5	0	0	0
23	0	0	0	.5	1.31	.25	2.33	.17
30	1	.25	.75	.05	1.38	.62	2	.83
May 7	2.5	.13	3	.4	3.18	.43	4.83	.83
14	2.81	.31	11.6	1.9	4.62	.25	4.5	1.83
21	4.31	1.1	12	2.5	13.38	2.75	17.33	5
28	5.54	1.18	19.5	26	13.37	5.69	21.4	7.7
June 4	19.93	21.66	49	0	5.87	7.31	18.6	11.8
11	51.06	27.72	109.05	32	23.88	11.13	36	19.2
18	19.8	18.93	-----	----	27.25	15	39.8	20.6
29	43.5	26.68	75.6	18	25.13	8.38	34.8	12.8
July 2	25.6	17.31	27	6.66	28	13.87	40.8	14
9	63.4	30.5	88.3	38.33	31.5	13.56	50.8	24.8
16	106.56	149.2	155.8	83.8	30.25	14.69	46.4	23.2
23	73.25	53.81	104.4	49.2	24.6	11	32	17
30	78.37	30.75	105.62	46	24.55	12.22	23.25	12.25
Aug. 6	84.43	35.12	115.5	58.33	19.11	10.22	32.75	11.75
13	66.75	52.43	143.37	66.25	11.44	6.33	19.88	7.5
20	38.43	37.36	58.16	35.16	4.25	2.75	9.33	4
27	29.37	18.62	59.14	29.57	0	0	0	0
Sept. 3	49.25	26.62	27.16	19.83	0	0	0	0
10	3	6.5	3	13.35	0	0	0	0
17	8.75	5.25	13.5	6.5	0	0	0	0
24	21.06	10.18	8.83	7.66	0	0	0	0
Mean	29.59	21.14	45.81	20.85	10.88	5.05	16.17	7.23

[1] See table 2 footnote.

TABLE 4.—*Comparison of hatch of cabbage looper eggs taken from collard plants in 400-square mile area and in Moultrie area, each trap in both areas baited with 0.1 gram of female cabbage looper sex pheromone* [1]

Date	1968 hatch		1969 hatch	
	400-mile area	Moultrie area	400-mile area	Moultrie area
	Percent	*Percent*	*Percent*	*Percent*
Apr. 30	63	75	60	71
May 7	60	75	67	67
14	66	80	63	67
21	63	82	82	80
28	76	82	60	71
June 4	80	78	67	79
11	56	67	63	72
18	66	--	60	72
25	63	71	67	69
July 2	67	79	65	70
9	67		60	71
16	58	73	61	63
23	49	74	62	67
30	53	76	54	62
Aug. 3	65	71	59	61
10	68	77	62	66
17	66	73	65	71
24	67	79	0	0
Sept. 3	65	71	0	0
10	68	77	0	0
17	66	73	0	0
24	67	79	0	0
Mean	65	76	49	53

[1] See table 2 footnote.

TABLE 5.—*Effects of mating of cabbage looper moths in 400-square mile area and in Moultrie area, each trap in both areas baited with 0.1 gram of female cabbage looper sex pheromone* [1]

Year	Females examined	Females with spermatophores	Mated females	Spermatophores per mated female
	Number	*Number*	*Percent*	*Number*
		400-MILE AREA		
1968	74	42	56	2.0
1969	51	41	80	1.4
		MOULTRIE AREA		
1968	77	44	57	2.4
1969	94	76	81	1.9

[1] See table 2 footnote.

Discussion

Blacklight trap data obtained in the 400-square mile area indicated that the male looper population was reduced (table 2). However, this reduction had little effect on mating and fertility. We were unable to detect any relationship between distances from the center of the 400-mile area with any of the criteria used in evaluating the effect of the traps on this insect. This fact suggests two possibilities. (1) Three traps per square mile were not sufficient to eliminate the effect of migrant moths into the trapped area. (2) The rate of reproduction would remain equal throughout the area if mating and fertility were not significantly reduced. During 1968 and 1969 the economic level of the looper population arrived later in the season and at lower levels than in 1967. Female trap catch was at such low levels little significance could be attributed to spermatophore count. In 1968 and 1969 very little insecticide was applied to control cabbage loopers on shade tobacco. Damage from the looper was almost nonexistent. However, because of the high value of the crop, the total number of insecticide applications was not reduced. The growers made one to two applications per week to control other insects and as a preventive measure for the looper. Prior to 1968 the cabbage looper was considered to be one of the major economic pests of shade-grown tobacco.

These preliminary results indicate a favorable suppression of the cabbage looper, and evaluation of the program is continuing.

Summary

Studies were conducted from 1967 to 1969 near Quincy, Fla., to determine the effectiveness of blacklight traps baited with the synthetic female sex pheromone for large area control of the cabbage looper (*Trichoplusia ni* (Hübner)) on cigar-wrapper tobacco. After all the traps were baited in 1968 and 1969, looper populations developed later, were smaller, and decreased earlier than in 1967, when only 13 traps were baited. The males trapped in the Moultrie, Ga., area (check) in 1968 and 1969 averaged 4.3 times more than the males caught in the 400-square mile trapping area. This marked decrease in male population had little effect on mating and fertility in the latter area.

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